Claims

1. A method for the manufacture of a patterned optical element comprising the steps of:

forming an alignment layer comprising a spatially patterned periodic surface relief microstructure formed into a suitable receptive material;

laying down a coating material that exhibits a liquid crystal phase onto the alignment layer enabling alignment of the coating material with the microstructure of the alignment layer;

forming the coating material into a solid film such that the molecular alignment between film and alignment layer is substantially preserved.

2. The method of claim 1 wherein the coating material is a lyotropic liquid crystal and the solid film forming step comprises removal of solvent to such point that a solid phase is formed from the coating layer.

3. The method of claim 1 wherein the coating material is a polymerisable liquid crystal and the solid film forming step comprises polymerisation of the liquid crystal layer.

4. The method of claim 3 wherein the polymerisable liquid crystal is photocurable and the polymerisation step comprises the step of photocuring the liquid crystal layer.

5. The method of claim 4 wherein the photocurable liquid crystal is UV-curable and the polymerisation step comprises the step of UV-photocuring the liquid crystal layer.

6. The method of any preceding claim wherein the surface relief microstructure is deposited on or integrally formed as part of a suitable

supporting substrate, the coating material being deposited thereupon to form an aligned layer such that the substrate comprises a suitable substrate for a device or a part thereof created by formation of the aligned layer.

7. The method of one of claims 1 to 4 wherein the surface relief microstructure is deposited on or integrally formed as part of a suitable fabrication substrate the coating material being deposited thereupon to form an aligned layer, which aligned layer is subsequently transferred from the fabrication substrate to a second substrate comprising a suitable support substrate for a device or a part thereof comprising the aligned layer.

8. The method of any preceding claim wherein a coating material is deposited on a single alignment layer.

9. The method of one of claims 1 to 7 wherein a plurality of laterally spaced alignment layers are used and coating material is deposited and solidified therebetween.

10. The method of claim 8 wherein two alignment layers are used, one either side of the coating material to align the coating material.

11. The method of any preceding claim wherein the spatially patterned monograting-like surface relief microstructure is first fabricated by photolithography in that a photoresist material is exposed using a photomask that has both the required pattern for the macroscopic spatial patterning of the microstructure and the microscopic pattern for producing the microstructure itself.

12. The method of one of claims 1 to 10 wherein a replication method is used to produce the surface relief microstructure.

13. The method of claim 12 wherein the surface relief microstructure is prepared by a two stage process of first creating a mould tool comprising a spatially patterned monograting-like surface relief microstructure and then forming the surface relief pattern into a suitable receptive material using the said mould tool.

14. The method of claim 13 wherein a single master is first created comprising a spatially patterned monograting-like surface relief microstructure and this single master is then used to prepare one or more of the said mould tools.

15. The method of claim 14 wherein the surface relief microstructure is prepared by first forming a master pattern having a contoured metallized surface which conforms to the required relief structure, electroforming a layer of a first metal onto the metallized surface to form a metal master, releasing the metal master from the master pattern, repeating the electroforming process to form a metal embossing shim, whether a shim plate or in the preferred embodiment a join-free metal shim tube, and embossing the relief structure into a polymer film so as to provide an embossed film having the desired mould features.

16. The method of one of claims 12 to 15 wherein the replication method comprises embossing the surface relief microstructure into a coating material, such as a photocurable polymer resin material, coated as a thin layer onto a suitable substrate.

17. The method of claim 16 wherein the replication method is a continuous embossing process wherein a relief forming material which comprises an organic or inorganic material or precursor thereof which is polymerisable, and in particular which is curable or thermally formable is applied to a supporting first layer having a receptive surface capable of retaining the relief forming material by reaction forming or micromoulding with use of an advancing line of contact along and progressing across the surface of the supporting layer to provide a surface relief microstructured layer retained on the supporting layer.

18. The method of any preceding claim wherein the periodic microstructure is formed with a period below 5.0 μm.

19. The method of claim 17 wherein the periodic microstructure is formed with a period in the range 0.2 to 1.0 μm.

20. The method of any preceding claim wherein the period is non-uniform across the relief-patterned area, being different for different regions of the relief-patterned area and/or varying across the relief-patterned area.

21. The method of any preceding claim wherein the periodic microstructure is formed with a sub-micron depth.

22. The method of claim 20 wherein the periodic microstructure is formed with a depth in the range 60 to 350 nm.

23. The method of any preceding claim wherein the depth is non-uniform across the relief-patterned area, being different with different direction of grooves, for different regions of the relief-patterned area and/or varying across the relief-patterned area.

24. A method for the manufacture of patterned optical elements comprising the method of any preceding claim used repeatedly so as to build up a series of optically functional layers so as to give the patterned optical element additional optical functionality.

25. A method for the manufacture of patterned optical elements comprising the method of any preceding claim and further comprising simultaneously or sequentially forming one or more secondary layers to give the patterned optical element additional optical functionality.

26. A method for the manufacture of patterned optical elements in accordance with claim 25 comprising depositing a reflective layer simultaneously or sequentially with the or a coating layer.

27. A patterned optical element manufactured by the method of any preceding claim.

28. A patterned optical element comprising a spatially patterned periodic surface relief microstructure fabricated from a suitable pattern-receptive material, and optionally laid down upon a supporting substrate; and an optically active coating layer of aligned material solidified from a liquid crystal phase such that a molecular alignment between the coating layer and alignment layer established during the said liquid crystal phase is substantially preserved.

29. A method for the manufacture of a patterned optical element or a patterned optical element substantially as hereinbefore described with reference to the accompanying drawings.